**IN THE UNITED STATES DISTRICT COURT**
**FOR THE DISTRICT OF MASSACHUSETTS**

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| SINGULAR COMPUTING LLC,<br><br>Plaintiff,<br><br>v.<br><br>GOOGLE LLC,<br><br>Defendant. | C.A. No. 1:19-cv-12551-FDS<br><br>Hon. F. Dennis Saylor IV |

**DEFENDANT GOOGLE LLC'S OPPOSITION TO MOTION TO EXCLUDE CERTAIN TESTIMONY OF LAURA B. STAMM AND DR. MARTIN WALKER REGARDING REASONABLE ROYALTY**

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Singular has moved to exclude a subset of the opinions of Google's damages and technical experts primarily based on the argument that Google failed to disclose a non-infringing alternative during discovery. That alternative, which Singular has not claimed to be infringing, is similar to the Accused Products in this case, except that it would perform math using a different number format (*i.e.*, "bfloat20" instead of the "bfloat16" format that Google currently uses). But the problem with Singular's argument is that Google *did* disclose this alternative nearly two years ago during fact discovery.

Singular conspicuously fails to quote any portion of the interrogatory response in which Google disclosed the bfloat20 alternative that Singular now seeks to preclude. In that response, Google disclosed as a non-infringing alternative versions of its TPUs "that have been modified to avoid the allegedly infringing functionality by, for example, representing numbers using formats other than bfloat16." In the same response, Google then more specifically pointed to the use of number "formats that represent numbers using an exponent of 8 bits, a sign bit, and a fraction of up to 15 bits." That latter disclosure accurately describes bfloat20, which is made up of an exponent of 8 bits, a sign bit, and a fraction of 11 bits. Essentially, Google said "use a non-infringing format with the same number of exponent bits but 15 or fewer fraction bits," and Singular now seeks to exclude Google's reliance on a format using 11 fraction bits even though that format falls squarely within Google's interrogatory response. Singular has been on notice of the bfloat20 alternative since 2021. There is no basis to preclude Google's experts from testifying about it here.

Singular's motion also tries to exclude the same testimony on two other grounds: (1) the bfloat20 alternative was allegedly not "available" at the time of the hypothetical negotiation and any related opinion is therefore too unreliable to be presented to the jury; and (2) Google's

damages expert, Laura Stamm, supposedly opines that damages here are capped at the cost of implementing the bfloat20 alternative. Neither of these arguments fares better than the first.

Singular misunderstands what is required to make an alternative "available" in the context of a reasonable royalty analysis. As an initial matter, the question of availability goes to weight, not admissibility. Moreover, in the limited circumstances where courts have addressed the test for availability, they have not applied the "on the market" test that Singular posits. Rather, they have found it sufficient that the alleged infringer had the "necessary equipment, know-how, and experience" to make the alternative available. Pursuant to that caselaw, the bfloat20 alternative *was* available at the time of the first alleged infringement here. Finally, Singular's characterization of Ms. Stamm's opinion is simply inaccurate: she has not opined that damages are "capped" at the cost to Google of implementing the bfloat20 alternative. Instead, consistent with black letter law and basic economics, she will testify that Google would have approached any hypothetical negotiation with an understanding of the costs of an alternative design that undisputedly does not infringe.

In short, there is no basis in either law or fact for Singular's motion, which should be denied. Google's experts should be permitted to testify to the bfloat20 alternative that Google disclosed long ago.

## I. FACTUAL BACKGROUND

The accused products in this case—Google's TPU v2 and v3 chips—perform certain mathematical operations on a number format called bfloat16, also known as BF16. Singular relies on Google's use of the bfloat16 number format as a key part of its infringement theory. *See, e.g.*, Decl. of Matthias Kamber (Kamber Decl.), Ex. A ("Khatri Rpt.) ¶¶ 102–106; 144–155.

Put simply[1], Singular contends that matrix multiplication operations that include the bfloat16 number format may result in an error rate covered by the Asserted Claims.[2] Analyzing the significant flaws and misstatements in Singular's motion requires a brief explanation of how computers use floating-point numbers in the bfloat16 format and similar formats.

Floating-point formats act like scientific notation for computers. *See* Kamber Decl., Ex. C ("Walker Rpt.") ¶¶ 45–59. Scientific notation provides a convenient way to represent very large or small numbers in a typographically feasible way. *Id.* ¶¶ 38–44. As explained by Google's technical expert, Dr. Walker, a decimal number written in scientific notation has two parts: the **exponent** part, which gives its power of 10 (e.g., $10^3 = 10 \times 10 \times 10 = 1000$), and its **mantissa**[3] part, which gives its "significant digits," a value between two powers of 10. Its general form is *mantissa* x $10^{exponent}$. *Id.* ¶¶ 33–59. For example, the number 1.5 can be written as $1.5 \times 10^0$, $0.15 \times 10^1$, or $15 \times 10^{-1}$, as they are all equivalent ($1.5 \times 1 = 0.15 \times 10 = 15 \times 0.1$). *Id.* ¶ 40.

bfloat16 is a floating-point number format. Several courts, including the Federal Circuit, have explained floating-point number formats:

> In floating point format, data is represented by the product of a

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[1] As explained in more detail in Google's motion for summary judgment on non-infringement, Singular's infringement theory is not just that operations on the bfloat16 format lead to the error rate, but it's the combination of the rounding operations in the Vector Processing Unit of the TPU and the BF16 multiplication operations outside of the Vector Processing Unit that allegedly lead to the error rate. *See generally* Dkt. 461.

[2] The Asserted Claims are directed to a "processor or other device" that "includes processing elements designed to perform arithmetic operations" with low precision and high dynamic range ("LPHDR"). *See, e.g.*, Kamber Decl., Ex. B ('273 Patent) at Abstract. These LPHDR execution units must accept a dynamic range of the possible valid inputs that is at least as wide as from 1/1,000,000 through 1,000,000. *Id.* at 30. The Asserted Claims also require that for at least 5% of the valid inputs, the LPHDR execution unit outputs a signal that represents a numerical value that differs from the result of an exact mathematical calculation by at least 0.05%. *Id.*

[3] As Singular's expert also acknowledges, the terms fraction and mantissa are used interchangeably when discussing floating-point number formats in computing. *See* Khatri Rpt. ¶¶ 154–155 (equating the term fraction with mantissa).

> **fraction, or mantissa, and a number raised to an exponent.** For example, a number *n* can be represented in base 10 by $\boldsymbol{n = m \times 10^{e}}$, where *m* is the mantissa and *e* is the exponent. If *m* equals 2 and *e* equals 1, *n* equals 20; if *m* equals 2 and *e* equals -1, then *n* equals 0.2. . . .

*Silicon Graphics, Inc. v. ATI Techs., Inc.*, 607 F.3d 784, 787 (Fed. Cir. 2010) (emphasis added).[4]

Floating-point numbers for computing purposes assign a certain number of bits to represent different numerical components: fraction (or mantissa) bits, exponent bits, and a sign bit[5]. *See* Walker Rpt. ¶¶ 45-74. As shown in the table below, all floating-point number formats have a specified precision level, which is nothing more than the number of digits in the mantissa (*m*). *Id.* The limits of a floating-point number's range are determined by the number of exponent (*e*) bits in the number format. *Id.* Thus, the total number of bits and the distribution of those bits between the exponent and the mantissa determine the mathematical precision and range of a floating-point number format. *Id.* Under Singular's infringement theory, that distribution of bits is necessary to understanding the error rate that results from using a particular number format for multiplication operations.[6] As shown in the table below, bfloat16 has 8 exponent bits, 7 mantissa bits, and 1 sign bit. *See id.* ¶ 71.

Under Singular's infringement theory, converting numbers from single-precision floating-point format (which has 8 exponent bits, 23 mantissa bits, and 1 sign bit) to bfloat16 format and then doing exact multiplication meets the 0.05% error limitation set forth in the

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[4] *See also Uniloc USA, Inc. v. Rackspace Hosting, Inc.*, 18 F. Supp. 3d 831, 834 (E.D. Tex. 2013). Both the bfloat16 and the bfloat20 number format are binary, rather than decimal, formats. *See* Walker Rpt. at ¶¶ 53-55.

[5] Floating point formats typically include a "sign bit," which indicates whether a number is greater or less than zero. *See* Walker Rpt. ¶ 46 n.2.

[6] Dr. Walker explains in his report on non-infringement why Singular's theory is incorrect; however, the portions of his opinions at issue here offer a non-infringing alternative even if Singular's infringement theory is accepted. *See generally* Walker Rpt.

Asserted Claims. Importantly, however, converting from single-precision to other floating-point number formats and then doing exact multiplication may not meet the error and dynamic range limitations of the Asserted Claims under Singular's infringement theory, depending on the format used.

Thus, as one non-infringing alternative, Google disclosed a modified version of the accused TPU v2 and v3 chips that would use a limited range of alternative number formats within the matrix multiplication unit, which performs a combination of multiplication and addition operations. *See infra* Section II.A. The use of such number formats would not infringe the Asserted Patents because, even under Singular's theory, they would not meet the error required by the Asserted Claims. One of the specific number formats within that range is bfloat20, also known as BF20. As shown in the table below, although bfloat16 and bfloat20 have the same dynamic range, bfloat20 includes more mantissa bits than bfloat16.

**Table 1: Bfloat Number Formats By Components**

| | Sign Bits | Exponent Bits (*impacts range*) | Mantissa[7] Bits (*impacts precision*) | Total Bits (Sign + Exponent + Mantissa) |
|---|---|---|---|---|
| bfloat16 | 1 | 8 | 7 | 16 |
| bfloat20 | 1 | 8 | 11 | 20 |

Singular does not dispute that using a bfloat20 number format would not meet the 0.05% error limitation set forth in the Asserted Claims under its infringement theory.[8]

[7] The mantissa can also be referred to as the "significand."
[8] A depiction of these disclosed number formats and the differences in mantissa bits is also provided in Figure 1 below.

## II. PROCEDURAL BACKGROUND

### A. Google identified the bfloat20 alternative during fact discovery.

Singular filed its initial complaint in this case in December 2019 and the operative First Amended Complaint ("FAC") in March 2020. In the FAC, Singular alleged that Google's TPUv2 and TPUv3 chips infringe because they contain execution units that use bfloat16 for multiplication in a way that results in the claimed error rate. *See, e.g.,* FAC ¶¶ 90-97.

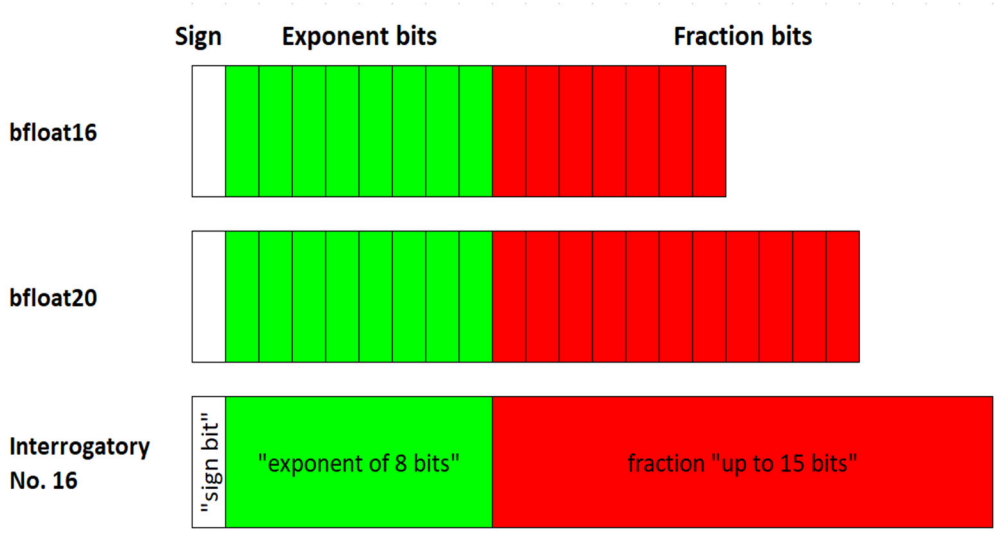
Over a year later, and less than four months before the end of fact discovery, Singular served an interrogatory regarding Google's non-infringing alternatives, Interrogatory No. 16. *See* Kamber Decl., Ex. D at 5-6. Google timely served its objections and responses and subsequently supplemented those responses as additional information came to light in discovery. *See* Kamber Decl. ¶ 7. Roughly a month before the close of fact discovery Google supplemented its response to Interrogatory No. 16 to include the following language:

> [N]on-infringing alternatives to the accused TPUv2 and TPUv3 include devices or techniques, or systems incorporating devices or techniques, that have been designed or adapted to perform machine learning processes **using numerical formats other than bfloat16** and/or that use prior art techniques for hardware and software implementation of arithmetic operations and various number formats. . . . Examples of such techniques, devices, and systems include, but are not limited to: . . . **[v]ersions of the TPUv2 and TPUv3 that have been modified to avoid the allegedly infringing functionality by, for example, representing numbers using formats other than bfloat16**, including the IEEE 754 half-precision floating-point number format, . . . **formats that represent numbers using an exponent of 8 bits, a sign bit, and a fraction of up to 15 bits, which the TPUv2 and TPUv3 MXU multiplier could have supported with no modification or limited modification;** or any other number format.

Kamber Decl., Ex. E. (Google's Second Supplemental Responses & Objections to Singular's Third Set of Interrogatories) at 10-11 (emphasis added). As explained above, Google's response disclosed non-infringing number formats as alternatives to the use of bfloat16 in TPUv2 and

TPUv3 chips. Those alternatives include the use of floating-point formats with an exponent of 8 bits, a sign bit, and a fraction (mantissa) of up to 15 bits.[9] Those alternatives encompass, among other formats, bfloat20, as shown in the image below.

**Figure 1: Number Formats by Bits**




This supplemental response was provided to Singular roughly two weeks prior to the deposition of any Google witness with knowledge relevant to non-infringing alternatives, including all of Google's Rule 30(b)(6) designees. Kamber Decl. ¶ 7. Google continued to include this language in subsequent supplemental responses to Singular's Interrogatory No. 16, all of which were served before the close of fact discovery. *See id.*; *see also id*, Ex. F at 16. Singular never sought further supplementation of, or moved to compel further responses to,

[9] Singular cannot credibly claim that this description of number formats is something Singular did not understand or was unfamiliar with. Indeed, the patents Singular asserted against Google in its now-dismissed second lawsuit contain limitations framed in a similar way and describe a "computing system . . . wherein the first, second, third, fourth and fifth arithmetic units each comprises a first corresponding multiplier circuit adapted to receive as a first input to the corresponding multiplier circuit a first **floating point value having a first binary mantissa of width no more than 11 bits and a first binary exponent of width at least 6 bits**." Kamber Decl., Ex. G ('616 Patent) at 32:58–33:44 (emphasis added).

Interrogatory No. 16 on non-infringing alternatives. Kamber Decl. ¶ 9.

Separately, during fact discovery, Google produced documents that referenced the availability and existence of bfloat20 and similar number formats. Google produced documents showing how Google tested a range of number formats when developing and designing its TPU chips, documents which one of Google's 30(b)(6) witnesses referenced during his deposition. *See id.*, Ex. H; *see also id.*, Ex. I (Jouppi Depo. Tr.) at 113:8-17; 151:24-152:8. Moreover, Google's first production in September 2020 included a publicly available patent issued to Google: U.S. Patent No. 10,621,269 (the "'269 Patent"), titled "Performing Matrix Multiplication in Hardware." Kamber Decl., Ex. K ('269 Patent); *id.* at ¶ 15. The '269 Patent specifically discussed the use of a 20-bit "expanded bfloat" format in matrix multiplication for machine learning:

> Examples of floating points formats include an IEEE single-precision format, a bfloat format, and an **expanded bfloat format.** The IEEE single-precision format is a 32-bit format that includes a sign bit, 8 bits of exponent, and a 23 bits of significand. A bfloat format is a 16-bit format that has a sign bit, 8 bits of exponent, and 7 bits of significand. **An expanded bfloat format is a 20-bit format that includes** a 20-bit format that includes *[sic]* **a sign bit, 8 bits of exponent, and 11 bits of significand.** Importantly, all the three formats noted above have the same exponent size and thus the same dynamic range. However, the single-precision format allows for more precision than the expanded bfloat format, and **the expanded bfloat format allows for more precision than the bfloat format**.

'269 Patent at 15:7–22. The '269 Patent claims priority to a provisional patent application Google filed in May 2017. Kamber Decl. ¶ 15. Google's disclosure did not go unnoticed; one month later in October 2020, Singular specifically requested that Google designate a witness on Topic 32: "US Patent No. 10,621,269." Ex. L (Singular's First 30(b)(6) Notice to Google) at 7.[10]

[10] Singular omitted this topic in a subsequent amended Rule 30(b)(6) notice and ultimately did

**B. Singular had the opportunity to depose witnesses about Google's bfloat20 alternative during fact discovery.**

As noted above, Google provided its bfloat20 interrogatory responses and relevant document productions to Singular prior to any depositions of Google witnesses with relevant knowledge regarding non-infringing alternatives. Kamber Decl. ¶¶ 7–8, 11, 13–14. Singular took the depositions of Drs. Norm Jouppi and Nishant Patil on July 16, 2021. *Id.* ¶ 12. Dr. Patil was Google's 30(b)(6) witness on Topic 42, "comparisons between the accused TPU v2 and TPU v3 and alternatives for machine-learning training."[11] *Id.* ¶ 14. Dr. Jouppi was Google's 30(b)(6) witness on Topic 7, "[a]ny patents or patent applications filed by Google that describe any aspect of the Accused Products; any continuations, continuations-in-part, or divisions thereof; and any reissues or extensions thereof." *Id.* ¶ 13.

Despite asking Google's witnesses about other interrogatory responses, Singular did not ask any of Google's witnesses about Google's response to Interrogatory No. 16 or alternative number formats identified therein. *Id.* ¶ 17. Neither did Singular ask any of Google's witnesses about the '269 Patent or its disclosure of a 20-bit expanded bfloat number format with 11 bits of significand (mantissa). *Id.* ¶ 18.

**C. Singular's experts had an opportunity to respond to Google's disclosure of alternatives based on number formats including bfloat20.**

The report of Singular's technical expert, Dr. Sunil Khatri, provides no indication that Dr. Khatri reviewed Google's response to Interrogatory No. 16. *Id.* ¶ 3. Although Singular's

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not pursue a corporate deponent on the '269 Patent alone. Instead, Google designated a witness on "[a]ny patents or patent applications filed by Google that describe any aspect of the Accused Products; any continuations, continuations-in-part, or divisions thereof; and any reissues or extensions thereof." *See* infra at 9.

[11] Notably, Singular's lengthy set of Rule 30(b)(6) topics did not include a topic equivalent to its Interrogatory No. 16 (i.e., targeting Google's contentions as to non-infringing alternatives).

damages expert, Mr. Philip Green, reviewed Google's response to Interrogatory No. 16, he made no reference to the alternative number formats disclosed in that response, including the bfloat20 alternative at issue in this motion. *Id.* ¶ 19; *see also id.* Ex. M.

Google provided expert analysis regarding its bfloat20 alternative design in the reports of its technical expert, Dr. Martin Walker, and its damages expert, Laura Stamm. Both of Google's experts relied on witnesses that Singular deposed during fact discovery—Drs. Patil and Jouppi. *See id.* Exs. C and N. Google provided Ms. Stamm and Dr. Walker's expert reports to Singular well before the depositions of Singular's own experts. Nevertheless, Singular chose not to provide its technical expert, Dr. Khatri, with a copy of either report for review prior to his deposition. Kamber Decl. ¶ 21. Singular had the ability to ask both Ms. Stamm and Dr. Walker about the bfloat20 alternative and did so during their depositions.

## III. ARGUMENT

### A. Google disclosed the bfloat20 non-infringing alternative.

Singular's infringement contentions are based, in part, on the use of the bfloat16 number format in the accused TPUs. Google's technical expert, Dr. Walker, and its damages expert, Ms. Stamm, both opine about a non-infringing alternative in which Google uses a different number format, bfloat20, in place of bfloat16. Singular has never suggested that bfloat20 would infringe. Instead, Singular has moved to exclude any testimony related to the bfloat20 alternative, claiming that Google failed to disclose this alternative during discovery. That claim is false.

*First*, Singular complains about Google's response to its interrogatory seeking non-infringing alternative contentions, claiming that "Google's response did not identify a 'bf20' format." Mot. at 4. Singular then devotes nearly a full page of its brief to quoting its interrogatory *request*, but tellingly does not quote Google's *response*. *Id.* at 3-4. In so doing, Singular ignores that nearly two years ago Google identified in its response alternative, non-

infringing number formats, including the bfloat20 alternative that Singular now seeks to exclude:

> [N]on-infringing alternatives to the accused TPUv2 and TPUv3 include devices or techniques, or systems incorporating devices or techniques, that have been designed or adapted to perform machine learning processes **using numerical formats other than bfloat16**[.] . . . Examples of such techniques, devices, and systems include, but are not limited to: . . . **[v]ersions of the TPUv2 and TPUv3 that have been modified to avoid the allegedly infringing functionality by, for example, representing numbers using formats other than bfloat16**, including the IEEE 754 half-precision floating-point number format, . . . **formats that represent numbers using an exponent of 8 bits, a sign bit, and a fraction of up to 15 bits, which the TPUv2 and TPUv3 MXU multiplier could have supported with no modification or limited modification;** or any other number format.

Ex. E at 10-11 (emphasis added). As discussed above, bfloat20 is a floating-point format that represents numbers using 8 exponent bits, a sign bit, and a fraction of fewer than 15 bits, just as described in Google's response to Singular's Interrogatory No. 16. *See supra* at 6-8.

*Second,* Singular also incorrectly claims Google failed to disclose bfloat20 in deposition testimony, arguing that "Google's corporate deposition witness likewise failed to identify any alternative that used a 'bf20' format." Mot. at 4. More specifically, Singular claims that "the only allegedly non-infringing substitutes identified by Dr. Patil were 'GPU systems.'" *Id.*

Singular's description of his testimony leaves the impression that Dr. Patil was asked at deposition to identify any non-infringing alternatives to the Accused Products and he named only GPUs. That is not the case. Dr. Patil was designated as a corporate witness on several topics, including Google's "[a]nalysis of the relative benefits, performance, and cost prepared by or for Google of any non-infringing alternatives or acceptable substitutes for the Accused Products." *Id.* At his deposition, however, Singular's counsel never asked about **any** non-infringing alternatives or acceptable substitutes. Instead, the testimony Singular relies on in its motion came during a discussion of a separate Rule 30(b)(6) topic related to "Google's decision to develop,

build and implement in its data centers the Accused Products." Kamber Decl., Ex. L at 5. In that context, Dr. Patil was asked what alternatives to TPU systems he had personally evaluated at the time Google incorporated TPUs in its data centers. *This testimony is unrelated to the issue of non-infringing alternative designs of the TPUs themselves*:

> Q. Were you involved in the decision to use the TPU v2 and v3 chips in Google's data centers in the United States?
> A. "Involved" is subjective.· I did help the data preparation.
> Q. You helped the data preparation. And what particular data did you prepare in order to inform that decision?
> A. The performance and system architecture.
> Q. Did you put together specific documents?
> A. I provided input to presentations.
> Q. What particular input did you provide?
> A. Alternatives possible.
> Q. What alternatives possible did you identify?
> A. GPU systems.

Kamber Decl. Ex. J (Patil Tr.) at 108:3-20. Singular did not ask Dr. Patil about non-infringing alternatives generally, Google's response to Interrogatory No. 16, or the number formats identified therein. As with Google's interrogatory answer, Singular tellingly failed to quote the relevant portion of the transcript in its motion.

In reality, Singular never asked a single Google witness, let alone Dr. Patil, about that response. Nor did Singular ever ask Dr. Patil or any other witness to identify or otherwise address the non-infringing alternatives to the Accused Products that were available to Google. Having failed to ask those questions, Singular has no basis to preclude Google's experts from testifying about the bfloat20 number format.

The two cases Singular relies on do not support precluding testimony regarding bfloat20.

In one, it was undisputed that the defendant attempted to introduce facts for the first time in an expert report after the close of fact discovery. *Niazi Licensing Corp. v. St. Jude Med. S.c., Inc*., No. 17-CV-5096 (WMW/BRT), 2020 WL 3638771 (D. Minn. July 6, 2020), *aff'd*, 30 F.4th 1339 (Fed. Cir. 2022). Indeed, the defendant "explained to the magistrate judge that it failed to disclose certain facts pertaining to [its expert] because 'we were busy ... so we put off talking to [the expert] until we wrapped up, you know, what we were working on at the time." *Id.* at 1. The other case involved a defense expert who relied on information from non-disclosed fact witnesses in establishing his opinions. *GREE, Inc. v. Supercell Oy*, No. 219CV00070JRGRSP, 2020 WL 4288356, at *2 (E.D. Tex. July 27, 2020).

These cases[12] have no bearing here, where Google timely disclosed the bfloat20 alternative and each of the witnesses on which its experts rely; therefore, Singular's motion should be denied.

**B. The bfloat20 alternative was available at the time of the hypothetical negotiation.**

Singular next argues that Dr. Walker and Ms. Stamm should be precluded from testifying about the bfloat20 alternative because, Singular claims, it was not "available" at the time of the hypothetical negotiation. Mot. at 6–9. But Singular's argument depends on an inaccurate understanding of the law and a mischaracterization of the record.

First, Singular refers to Federal Rule of Evidence 403 as supporting the exclusion of testimony as to the bfloat20 alternative. Yet Singular makes no effort to explain why Rule 403 is relevant to the facts here. Nor does a single case it cites rely on or even discuss Rule 403 in the

[12] In both of these cases, orders to exclude expert testimony depended in large part on prejudice to the plaintiff based on the defendant's failure to disclose. Singular has not shown any prejudice it has suffered as a result of Google's purported failure to disclose.

context of discussing non-infringing alternatives.

Second, Singular's argument fails because it ignores the meaning of "available" in the context of a reasonable royalty analysis.[13] Federal Circuit precedent "permits available alternatives – including ***but not limited to*** products on the market." *Grain Processing Corp. v. Am. Maize-Prods. Co.*, 185 F.3d 1341, 1349 (emphasis added). In *Grain Processing*, the Federal Circuit noted that an available alternative existed where the infringer "could readily obtain all of the materials needed" to produce the substitute, that it "had all of the necessary equipment, know-how, and experience" to make the substitute, and that making the substitute was "not prohibitively expensive" to the infringer. *Id.* at 1353-54. Thus, the fact that the alternative was not on the market during the time of first infringement did not prevent it from being found to be an available non-infringing alternative. *See also Mars, Inc. v. Coin Acceptors, Inc.*, 527 F.3d 1359, 1373 (Fed. Cir. 2008) (mandate recalled and amended on other grounds) (holding that district court appropriately considered that defendant "did not have—but probably could have designed—an acceptable alternative" in awarding reasonable royalty).

Here, as Google's expert repeatedly testified,[14] the facts demonstrate that Google had the

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[13] Singular conflates two different damages standards in its motion: lost profits and reasonable royalty. Singular's motion repeatedly refers to the requirement that an alternative must be both "available" and "acceptable." But acceptability as a "yes-or-no" binary concept is the province of lost profits, and Singular does not seek lost profits. *See Salazar v. HTC Corp*., No. 216CV01096JRGRSP, 2018 WL 2033709, at *3 (E.D. Tex. Mar. 28, 2018) ("The concept of an 'acceptable non-infringing alternative' relates to a lost-profits damage model. . . ." and that "'acceptable non-infringing alternatives' don't play the same role in a reasonable-royalty determination"). While "acceptability" (as opposed to "availability") does not appear to be the basis for Singular's motion, an alternative that is acceptable, even if less acceptable, could still be germane to this case, where Singular seeks only a reasonable royalty. *Id.* Furthermore, Dr. Walker and Ms. Stamm's opinions both provide detailed analyses of why bfloat20 would have been acceptable to Google. *See*, *e.g.*, Kamber Decl., Ex. A (Walker Rpt.) ¶¶ 306–329; *Id.*, Ex. N (Stamm Rpt.) ¶¶ 76–77. Singular has offered no contrary expert opinion.

[14] *See, e.g.,* Kamber Decl., Ex. O (Stamm Tr.) at 27:7–20; 30:11–22.

"materials needed" to produce the bfloat20 alternative, it had the "know-how" to do so, and that doing so was "not prohibitively expensive." The Accused Products—Google's TPUv2 and TPUv3 chips—perform multiplication on numbers in the bfloat16 format. [redacted]

Consistent with these facts, Google's '269 Patent describes the use of an "expanded bfloat" format with 20 bits, *i.e.*, bfloat20. Ex. K at 15:14–16 ("An expanded bfloat format is a 20-bit format that includes a 20-bit format that includes a sign bit, 8 bits of exponent, and 11 bits of significand."). The '269 Patent specifically contemplates the use of bfloat20 for multiplication, because bfloat20 "allows for more precision than" the bfloat16 number format. *Id.* at 15:20-22. This patent, which Google produced and of which Singular was aware in 2020, was applied for on May 17, 2018, and relates to a provisional application filed on May 17, 2017 with the same specification language regarding a 20-bit, "expanded bfloat" format —around the

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15 [redacted] *See, e.g.*, Ex. O (Stamm Tr.) at 41:1-42:3. But, even if this were true, that issue would be one for the jury to consider, and does not justify a motion to strike. *See infra* at 16-17.

time of the hypothetical negotiation. *See* Kamber Decl. ¶ 15. That patent reflects that Google had the "necessary equipment, know-how, and experience" to implement a bfloat20 alternative in 2017. *Grain Processing*, 185 F.3d at 1353-54. Singular's motion fails to address these facts or acknowledge the explicit, publicly available language of the '269 Patent.

In short, in accordance with Federal Circuit caselaw, bfloat20 was "available" to Google at the time of first alleged infringement, and Google could have developed versions of its TPUs using this format in order to avoid purportedly infringing here. That is all the Federal Circuit requires for a non-infringing alternative to be "available." Notably, none of Singular's experts offer *any* analysis as to the availability of bfloat20, let alone any opinion it was *un*available.

Third, even if there were some question as to whether bfloat20 was "available," Singular's motion should still be denied. The question of whether an alternative design was "available" at the time of the hypothetical negotiation is one of weight, not admissibility, and should go to the jury. *See Verinata Health, Inc. v. Ariosa Diagnostics, Inc.*, No. 12-CV-05501-SI, 2018 WL 288050, at *5 (N.D. Cal. Jan. 4, 2018) (finding that objections to the availability of non-infringing alternatives "go to the weight rather than the admissibility of the evidence" and declining to preclude such testimony); *Greatbatch Ltd. v. AVX Corp.*, No. CV 13-723-LPS, 2015 WL 9171042, at *7 (D. Del. Dec. 11, 2015) (same), *aff'd*, 813 F. App'x 609 (Fed. Cir. 2020); *Carnegie Mellon Univ. v. Marvell Tech. Grp., Ltd.*, Civ. No. 09-290, 2012 WL 3686736, *4-*5 (W.D. Pa. Aug. 24, 2012) (denying motion to exclude two damages experts over patentee's objections that the experts did not know if the purported non-infringing alternatives had actually been built, tested or sold, and at what costs, as those details went to the factual question of the alternatives' existence, not the admissibility of the opinions).

In fact, that is precisely what happened in the cases that Singular cited, none of which

concerned a *Daubert* challenge on this basis.[16] For instance, in *Spectralytics, Inc. v. Cordis Corp.*, defendants argued that two non-infringing alternatives existed. 649 F.3d 1336 (Fed. Cir. 2011). Plaintiff objected that neither was available, as one "was not made until ten years after the infringement began" and the other "did not function." *Id.* at 1346. Nonetheless, defendants were permitted to present their availability argument to the jury. *Id.* The Federal Circuit did not hold that the alternatives were unavailable *as a matter of law,* but that the jury was entitled to reach its own conclusion, based on the evidence presented to it. *Id.* That supports Google's argument that any concern regarding availability is a question for the jury.

For all these reasons, the record here shows that the bfloat20 alternative was available at the time of the hypothetical negotiation. But, even if the relevant test doesn't dictate that it was available, that fact would still not justify excluding testimony on the alternative but instead would be an issue of weight for the jury. On either basis, Singular's motion should be denied and Dr. Walker and Ms. Stamm should be permitted to testify about the bfloat20 alternative.

### C. Ms. Stamm did not opine that damages would be "capped" at the cost of implementing the bfloat20 non-infringing alternative.

Singular claims that, "[i]n her report, Ms. Stamm also opines that a reasonable royalty in this case would be capped at the cost that Google [] would have incurred to implement the . . . 'bfloat20' chip." Mot. at 9. This approach, Singular argues, is "contrary to established Federal Circuit law." *Id.* at 10. But Singular's position is at odds with both the law and Ms. Stamm's actual opinion.[17]

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[16] Notably, one of Singular's citations does not include the language quoted in Singular's brief at all. *See* Mot at 8 (purporting to quote *SRI Int'l, Inc. v. Internet Sec. Sys., Inc.*, No. 04-1199, 2011 WL 5166436, at *2 (D. Del. Oct. 31, 2011)).

[17] Singular's motion also includes a reference to *SimpleAir, Inc. v. Google Inc.*, 77 F. Supp. 3d 569, 582 (E.D. Tex. 2014), *vacated on other grounds*, 820 F.3d 419 (Fed. Cir. 2016). Mot. at 10–11. This is a red herring and has no relevance to Ms. Stamm—who was not involved in that

Singular's argument relies on the following passage from Ms. Stamm's report:

> Google would have approached the negotiation with the position that it could design around the Asserted Claims by using a different number format, bfl20, that would not infringe the patents-in-suit. This alternative would result in Google incurring at most a present value amount of $12.9 million in added electrical and cooling expenses. These added costs inform the amount Google would be willing to pay for a license to the patents-in-suit that would allow it to benefit from the lower costs associated with the use of the Accused Chips.

Mot. at 10 (quoting Stamm Rpt. ¶ 180). Singular claims that this opinion runs afoul of the principle that defendants cannot, as a matter of law, "claim that reasonable royalty damages are capped at the cost of implementing the cheapest available, acceptable, noninfringing alternative." Mot. at 10 (citing *Mars,* 527 F.3d at 1373). Singular's reliance on *Mars* is misguided.

First, *Mars* is of no consequence in the *Daubert* context because that opinion does not relate to expert testimony or a *Daubert* challenge. Instead, the *Mars* opinion discusses a defendant's challenge to a judgment awarded following a damages bench trial in which the defendant argued that "the district court erred by awarding a reasonable royalty rate higher than the cost to [defendant] of implementing acceptable noninfringing alternatives." *Mars*, 527 F.3d at 1372. Indeed, numerous courts have rejected the argument Singular is making as an incorrect reading of *Mars*. *See, e.g., Ergotron, Inc. v. Rubbermaid Com. Prods., LLC,* Civ. No. 10-2010 ADM/JJG, 2012 WL 3733578 at *12 (D. Minn. Aug. 28, 2012) (collecting cases); *Kimberly-Clark Worldwide, Inc. v. First Quality Baby Prod.*, *LLC*, Civ. No. 1:09-CV-1685, 2013 WL 6036029, at *3 (M.D. Pa. Nov. 13, 2013) (holding that "the court examined the pertinent case law—including *Mars*—and concluded that it did not prohibit experts from testifying regarding

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case—or her opinion or testimony.

the behavior of economically rational actors. Rather, it stood for the proposition that courts could not cap infringement damages **as a matter of law** at the cost of creating a noninfringing alternative") (emphasis added); *see also Meridian Mfg., Inc. v. C & B Mfg., Inc.*, 340 F.Supp. 3d 808, 846 (N.D. Iowa 2018) (refusing to strike accused infringer's damages expert's opinion because the expert's "opinion does not place an automatic cap on damages at the cost of redesign" and instead "concludes based on the facts and circumstances of this case that a reasonable royalty would not exceed the cost of redesigning," an opinion more appropriate for cross-examination). Singular's reading of *Mars* should be rejected.

Second, Federal Circuit law is clear that damages experts are permitted to consider the cost of implementing a non-infringing alternative in their damages analysis. *See Zygo Corp. v. Wyko Corp.*, 79 F.3d 1563, 1571–72 (Fed. Cir. 1996). If, based on the facts and circumstances, an expert's reasonable royalty rate turns out to be in line with the cost difference, that, too, is appropriate. *See Riles v. Shell Expl. & Prod. Co.*, 298 F.3d 1302, 1312 (Fed. Cir. 2002) ("The economic relationship between the patented method and non-infringing alternative methods, of necessity, would limit the hypothetical negotiation."); *Grain Processing*, 185 F.3d at 1347 (finding that the difference between the production costs of the infringing and non-infringing products would "effectively cap[] the reasonable royalty award" because under the facts, the defendant would not have paid more than that in a hypothetical negotiation).

Third, even assuming counterfactually that Singular's reading of *Mars* is correct, Ms. Stamm never claimed that damages here are "capped" at the cost of implementing bfloat20. That is clear from the passages quoted in Singular's opening brief. *See, e.g.*, Mot. at 10. Instead, Ms. Stamm testified that, based on the facts and circumstances here—including the ready availability of non-infringing alternatives—the costs of implementing the bfloat20 alternative "*inform the*

*amount Google would be willing to pay* for a license to the patents-in-suit." *See* Kamber Decl. Ex. N (Stamm Rpt.) ¶ 180 (emphasis added). That argument is consistent with basic economic concepts and is not controversial. Indeed, Singular's damages expert Philip Green applied that same principle in his damages analysis: he calculated the upper bound of potential reasonable royalty damages as *equal to* the cost savings Google allegedly enjoyed by using the purported invention. *See* Kamber Decl. Ex. M, (Green Rpt.) at 4 ("I have concluded the royalties due Singular in this matter could amount to as much as approximately [redacted] based on the incremental cost savings that Google has experienced from its actual deployments of TPUs accused of infringing the Patents-In-Suit."). Moreover, as Singular acknowledges in a footnote, Ms. Stamm testified to another alternative to using bfloat16 on TPUs, the use of the half precision format on GPUs, which could have informed the parties' hypothetical negotiation. Mot. at 1 n.1. She opined that a negotiation based on this alternative would have led to a higher royalty. Kamber Dec., Ex. N (Stamm Rpt) ¶ 16. Singular has not moved to exclude this alternative. Mot. at 1 n.1. And its existence belies the notion that the Ms. Stamm treats the bfloat20 alternative as a "cap."

In short, there is no support in law or in fact for Singular's assertion that Ms. Stamm's opinions and testimony should be excluded on this basis. Singular is free to cross-examine Ms. Stamm on her analysis at trial, but her opinion is not inadmissible. *See Meridian Mfg., Inc. v. C & B Mfg., Inc.*, 340 F. Supp. 3d 808, 846 (N.D. Iowa 2018) (refusing to exclude the testimony of a damages expert who opined that a reasonable royalty would have been no more than the defendants' cost to implement a non-infringing alternative).

## IV. CONCLUSION

For the foregoing reasons, Singular's motion should be denied.

Respectfully submitted,

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